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DURIP-94: PHASE CONJUGATE INJECTION LOCKING OF LASER DIODE ARRAYS

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F49620-95-1-0103

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release: distribution unlimited

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13. ABSTRACT (Maximum 200 words)

This is an "equipment only" grant under the Defense University Research Instrumentation Program. A report of the results obtained with this equipment is contained in the final report for Grant F49620-95-1-0082, "Phase-Conjugate Injection Locking of Laser Diode Arrays." To avoid duplication of paperwork, only a partial summary of that report will be duplicated here. This grant is to produce high-brightness, narrow-frequency light beams from semiconductor laser arrays using optical phase conjugation. The investigators recently demonstrated that their proposed techniques are both practical and efficient, and can be applied to commercially available semiconductor lasers. Their experiments coupled an optical phase conjugator to a broad-area semiconductor laser, causing the laser to emit a 0.5 watt, near-diffraction-limited output beam. Their system is simple and compact, and it also automatically adjusts for any frequency drift or gradual misalignment of the optical components. The investigators extended their techniques from single, broad-area lasers to powerful semiconductor laser arrays.

14. SUBJECT TERMS
Lasers, phase conjugation

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Final Report

submitted to the
Air Force Office of Scientific Research
Bolling AFB, Building 410,
Washington, D.C. 20332-6448

ATTN.: Dr. Howard Schlossberg

1) Date submitted: MAY 4, 1997

2) Title: DURIP-94: PHASE CONJUGATE INJECTION LOCKING OF LASER DIODE ARRAYS

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4) Time period covered: DECEMBER 15, 1994 - DECEMBER 15, 1996

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6) Federal agency identifying award number: F49620-95-1-0103

DURIP-94: PHASE CONJUGATE INJECTION LOCKING OF LASER DIODE ARRAYS

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A) Summary of Overall Progress:

This goal of this project was to produce a high-brightness, narrow-frequency light beam from a semiconductor laser array. We used a mutually-pumped phase conjugator to couple a single-frequency master laser into a high-power diode laser array. This injected light narrowed the frequency bandwidth of the laser array's output beam. Tuning the master laser (by adjusting its current or its temperature) then smoothly tuned the laser array, while the output beam remained diffraction limited. We characterized and optimizing the mutually-pumped phase conjugator, which is the key element for aiming light from the injecting laser into the numerous lasers making up the laser array. We compared the performance of the four types of mutually-pumped phase conjugators for injecting light into a laser array. We have also pursued a number of other, related projects. In particular, we have published new results on the following:

1) We developed a new technique for detecting domains hidden in photorefractive crystals. These 180° domains are usually not wanted, for they diminish the efficiency of beam-coupling in such crystals. Our simple technique maps the location of any 180° domains in three dimensions.

2) We measured the phase of the light produced by frequency doubling in a self-phase matched optical fiber.

3) We measured the anisotropy of the mobility of holes in barium titanate crystals. We show that the drift mobility perpendicular to the crystal's c-axis is 40 times that along the c-axis.

B) Accomplishments/New Findings

See below and final report of grant F49620-95-1-0082

C) Current Problems or Unusual Developments:

None.

D) Changes from Original Proposal:

None.

E) Publications

S. C. de la Cruz, S. MacCormack, J. Feinberg, Q. B. He, H. K. Liu, and P. Yeh, "Effect of beam coherence on mutually pumped phase conjugators," J. Optical Society of America-B 12, 1363-1369 (1995).

V. Grubsky, S. MacCormack, and J. Feinberg, "All-optical three-dimensional mapping of 180° domains hidden in a $BaTiO_3$ crystal," Opt. Lett. 21, 6-8 (1996).

P. Lambelet and J. Feinberg, "Phase of second-harmonic light self-generated in a glass fiber," Opt. Lett. 21, 925-927 (1996).

D. Mahgerefteh, D. Kirillov, R. S. Cudney, G. D. Bacher, R. M. Pierce, and J. Feinberg, "Anisotropy of the hole drift mobility in barium titanate," Phys. Rev. B. 53, 7094 - 7098 (1996).

F) Personnel Supported

Equipment only.

G) Interactions

Contributed talks:

"Frequency locking of two elements of a laser diode array using mutually pumped phase conjugation," S.-C. De La Cruz, S. MacCormack, P. Lambelet and J. Feinberg, Photorefractive Materials, Effects and Devices, Estes Park, Colorado, June 11-14, 1995.

CLEO -96: "Dynamic mapping of 180° domains hidden in photorefractive crystals," Victor Grubsky, Stuart MacCormack and Jack Feinberg.

Nonlinear Optics: Materials, Fundamentals, and Applications (Maui, Hawaii): "Powerful, diffraction-limited semiconductor laser using photorefractive beam coupling," Stuart MacCormack, Jack Feinberg, Steve O'Brien, Robert J. Lang, Marvin B. Klein, Barry A. Wechsler

Collaborations with

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3) Marvin Klein and Barry Wechsler
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4) Steve O'Brien and Robert Lang
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5a) Q. Byron He and 5b) Hua-Kuang Liu
of the Jet Propulsion Laboratory,
California Institute of Technology,

6) Pochi Yeh
of the Department of Electrical and Computer Engineering,
University of California at Santa Barbara.

G) New Discoveries, Inventions, or Patent Disclosures

A new method for detecting and mapping 180° domains hidden in photorefractive crystals. No disclosure filed.

H) Honors or Awards

The principal investigator, Jack Feinberg, won a nice award: the 1995 Discover Award for "Technological Innovation In The Field Of Sight." This was a national competition. An article about this work was printed in the June, 1995 issue of Discover magazine.